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[N-Formyl-N'-(2-oxidobenzylidene)hydrazine- κ^3O,N,O']diphenyltin(IV)

Shaukat Shuja,^a Saqib Ali,^a Auke Meetsma,^b Grant A. Broker^c and Edward R. T. Tiekink^{c*}

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Key indicators

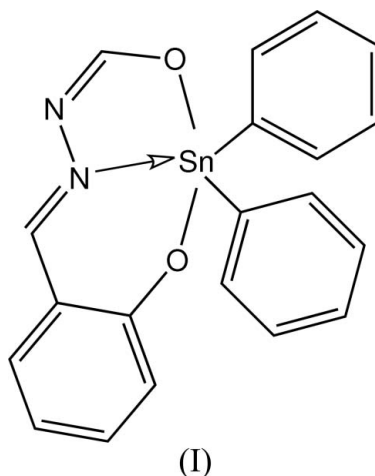
Single-crystal X-ray study
 $T = 100$ K
Mean $\sigma(\text{C}-\text{C}) = 0.004$ Å
 R factor = 0.022
 wR factor = 0.058
Data-to-parameter ratio = 14.6

For details of how these key indicators were automatically derived from the article, see <http://journals.iucr.org/e>.

The title compound, $[\text{Sn}(\text{C}_6\text{H}_5)_2(\text{C}_8\text{H}_6\text{N}_2\text{O}_2)]$, features a five-coordinate C_2NO_2 coordination geometry for Sn that is intermediate between trigonal-bipyramidal and square-pyramidal.

Comment

The title compound, (I), was investigated as a part of an ongoing investigation of the putative biological activities of organotin compounds (Rehman *et al.*, 2004; Gielen & Tiekink, 2005).



In (I) (Fig. 1 and Table 1), the Sn atom is coordinated by two O atoms and an N atom from the tridentate ligand and two *ipso*-C atoms belonging to the two phenyl substituents. The tin coordination is highly distorted, as seen in the value of $\tau = 0.56$, indicating a geometry biased towards trigonal bipyramidal ($\tau = 1.0$) rather than square pyramidal ($\tau = 0.0$; Addison *et al.*, 1984). The distortion can be rationalized in terms of the steric demands of the two chelate rings formed by the tridentate ligand. Similar structures have been found in the analogues in which the C1 position in (I) is substituted with Me ($\tau = 0.59$; Diouf *et al.*, 1999) and Ph ($\tau = 0.50$ and 0.55 for the two independent molecules; Dey *et al.*, 2003). The dihedral angles between the mean plane of the ligand and the C9 and C15 phenyl rings are 68.82 (9°) and 56.13 (10°), respectively. The angle between the C9 and C15 ring planes is 58.26 (12°).

In the crystal structure of (I), centrosymmetric pairs of molecules associate via $\text{C}-\text{H} \cdots \pi$ interactions (Table 2). Such an arrangement effectively blocks off both N atoms as well as the O2 atom from forming intermolecular contacts. The loosely associated dimers are connected into chains via $\text{C}-\text{H} \cdots \text{O}$ contacts (Fig. 2 and Table 2).

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Accepted 18 March 2007

Experimental

N-(2-Hydroxybenzylidene)formylhydrazide (2.5 mmol, 0.41 g) and Et₃N (5 mmol, 0.7 ml) were added to dry toluene (100 ml) in a round-bottom flask equipped with a reflux condenser. Diphenyltin(IV) dichloride (2.5 mmol, 0.86 g) dissolved in dry toluene (20 ml) was then added. The reaction mixture was stirred at room temperature for 5 h and allowed to stand overnight. The Et₃N·HCl that formed was filtered off and the clear yellow solution was evaporated on a rotary evaporator under reduced pressure. Crystals of (I) suitable for single crystal analysis were obtained by recrystallization from a chloroform solution; m.p = 389–391 K.

Crystal data

| | |
|--|---|
| [Sn(C ₆ H ₅) ₂ (C ₈ H ₆ N ₂ O ₂)] | $\gamma = 68.869 (1)^\circ$ |
| $M_r = 435.04$ | $V = 859.93 (8) \text{ \AA}^3$ |
| Triclinic, $P\bar{1}$ | $Z = 2$ |
| $a = 8.9903 (5) \text{ \AA}$ | Mo $K\alpha$ radiation |
| $b = 9.0639 (5) \text{ \AA}$ | $\mu = 1.50 \text{ mm}^{-1}$ |
| $c = 11.8622 (7) \text{ \AA}$ | $T = 100 (2) \text{ K}$ |
| $\alpha = 77.277 (1)^\circ$ | $0.49 \times 0.43 \times 0.39 \text{ mm}$ |
| $\beta = 74.324 (1)^\circ$ | |

Data collection

| | |
|--|--|
| Bruker SMART CCD diffractometer | 6594 measured reflections |
| Absorption correction: multi-scan (SADABS; Bruker, 2006) | 3297 independent reflections |
| $T_{\min} = 0.459$, $T_{\max} = 0.557$ | 3196 reflections with $I > 2\sigma(I)$ |
| | $R_{\text{int}} = 0.030$ |

Refinement

| | |
|---------------------------------|--|
| $R[F^2 > 2\sigma(F^2)] = 0.022$ | 226 parameters |
| $wR(F^2) = 0.058$ | H-atom parameters constrained |
| $S = 1.12$ | $\Delta\rho_{\text{max}} = 0.68 \text{ e \AA}^{-3}$ |
| 3297 reflections | $\Delta\rho_{\text{min}} = -0.74 \text{ e \AA}^{-3}$ |

Table 1

Selected geometric parameters (\AA , $^\circ$).

| | | | |
|----------|-------------|-----------|------------|
| Sn—O1 | 2.1470 (18) | Sn—C15 | 2.125 (2) |
| Sn—O2 | 2.0654 (17) | N1—C1 | 1.299 (3) |
| Sn—N2 | 2.162 (2) | N1—N2 | 1.411 (3) |
| Sn—C9 | 2.120 (2) | N2—C2 | 1.299 (3) |
| O1—Sn—O2 | 158.42 (7) | O2—Sn—N2 | 84.49 (7) |
| O1—Sn—N2 | 73.94 (7) | C9—Sn—C15 | 124.62 (9) |

Table 2

Hydrogen-bond geometry (\AA , $^\circ$).

| $D-H\cdots A$ | $D-H$ | $H\cdots A$ | $D\cdots A$ | $D-H\cdots A$ |
|-----------------------------------|-------|-------------|-------------|---------------|
| C2—H2 \cdots Cg ⁱ | 0.95 | 2.93 | 3.872 (3) | 172 |
| C19—H19 \cdots O1 ⁱⁱ | 0.95 | 2.67 | 3.554 (3) | 154 |

Symmetry codes: (i) $-x, -y, -z + 1$; (ii) $-x + 1, -y, -z$. Cg is the centroid of the C9–C14 ring.

H atoms were positioned geometrically ($C-H = 0.95 \text{ \AA}$) and refined as riding with $U_{\text{iso}}(\text{H}) = 1.2U_{\text{eq}}(\text{C})$.

Data collection: SMART (Bruker, 2006); cell refinement: SAINT-Plus (Bruker, 2006); data reduction: SAINT-Plus; program(s) used to solve structure: PATTY in DIRDIF92 (Beurskens *et al.*, 1992); program(s) used to refine structure: SHELXL97 (Sheldrick, 1997);

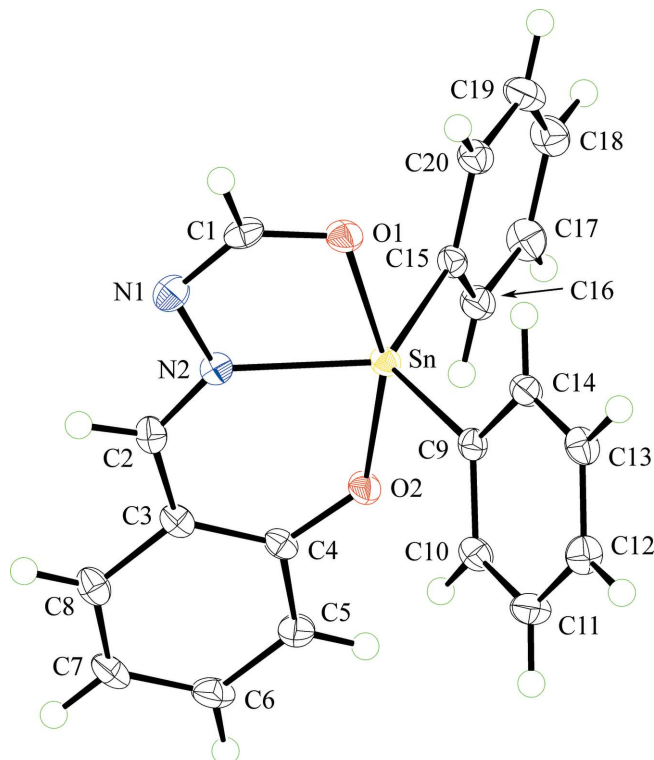


Figure 1

The molecular structure of (I), showing the atom labelling and displacement ellipsoids drawn at the 50% probability level (arbitrary spheres for the H atoms).

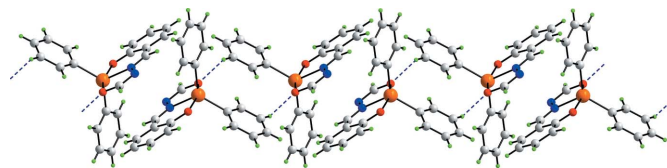


Figure 2

Chain formation via $C-H\cdots O$ (blue dashed lines) and $C-H\cdots\pi$ interactions in the crystal structure of (I). Colour code: Sn atoms are shown in orange, O atoms in red, N atom in blue, C atoms in grey and H atoms in green.

molecular graphics: ORTEPII (Johnson, 1976) and DIAMOND (Brandenburg, 2006); software used to prepare material for publication: SHELXL97.

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[*N*-Formyl-*N'*-(2-oxidobenzylidene)hydrazine- κ^3 O,*N*,*O'*]diphenyltin(IV)

Shaukat Shuja, Saqib Ali, Auke Meetsma, Grant A. Broker and Edward R. T. Tiekink

(I)

Crystal data

C₂₀H₁₆N₂O₂Sn

M_r = 435.04

Triclinic, *P*1

Hall symbol: -P 1

a = 8.9903 (5) Å

b = 9.0639 (5) Å

c = 11.8622 (7) Å

α = 77.277 (1)°

β = 74.324 (1)°

γ = 68.869 (1)°

V = 859.93 (8) Å³

Z = 2

F(000) = 432

D_x = 1.680 Mg m⁻³

Mo *K*α radiation, λ = 0.71073 Å

Cell parameters from 7180 reflections

θ = 2.4–29.6°

μ = 1.50 mm⁻¹

T = 100 K

Block, yellow

0.49 × 0.43 × 0.39 mm

Data collection

Bruker SMART CCD

diffractometer

Radiation source: fine-focus sealed tube

Graphite monochromator

Detector resolution: 4096x4096 / 62x62 (binned

512) pixels mm⁻¹

ω scans

Absorption correction: multi-scan

SADABS (Bruker, 2006)

*T*_{min} = 0.459, *T*_{max} = 0.557

6594 measured reflections

3297 independent reflections

3196 reflections with *I* > 2σ(*I*)

*R*_{int} = 0.030

θ_{max} = 26.0°, θ_{min} = 2.4°

h = -11→11

k = -11→10

l = -14→14

Refinement

Refinement on *F*²

Least-squares matrix: full

R [*F*² > 2σ(*F*²)] = 0.022

wR(*F*²) = 0.058

S = 1.12

3297 reflections

226 parameters

0 restraints

Primary atom site location: structure-invariant

direct methods

Secondary atom site location: difference Fourier map

Hydrogen site location: inferred from neighbouring sites

H-atom parameters constrained

w = 1/[σ²(*F*_o²) + (0.0258*P*)² + 0.9175*P*]

where *P* = (*F*_o² + 2*F*_c²)/3

(Δ/σ)_{max} < 0.001

Δρ_{max} = 0.68 e Å⁻³

Δρ_{min} = -0.74 e Å⁻³

Special details

Geometry. All e.s.d.'s (except the e.s.d. in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell e.s.d.'s are taken into account individually in the estimation of e.s.d.'s in distances, angles and torsion angles; correlations between e.s.d.'s in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell e.s.d.'s is used for estimating e.s.d.'s involving l.s. planes.

Refinement. Refinement of F^2 against ALL reflections. The weighted R -factor wR and goodness of fit S are based on F^2 , conventional R -factors R are based on F , with F set to zero for negative F^2 . The threshold expression of $F^2 > \sigma(F^2)$ is used only for calculating R -factors(gt) *etc.* and is not relevant to the choice of reflections for refinement. R -factors based on F^2 are statistically about twice as large as those based on F , and R -factors based on ALL data will be even larger.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (\AA^2)

| | <i>x</i> | <i>y</i> | <i>z</i> | $U_{\text{iso}}^*/U_{\text{eq}}$ |
|-----|---------------|---------------|---------------|----------------------------------|
| Sn | 0.073101 (18) | 0.179092 (18) | 0.246058 (13) | 0.01552 (7) |
| O1 | 0.2676 (2) | −0.0444 (2) | 0.24888 (15) | 0.0215 (4) |
| O2 | −0.1012 (2) | 0.3823 (2) | 0.30705 (15) | 0.0201 (4) |
| N1 | 0.2437 (3) | −0.0236 (3) | 0.44564 (19) | 0.0217 (4) |
| N2 | 0.1199 (2) | 0.1213 (2) | 0.42263 (17) | 0.0166 (4) |
| C1 | 0.3058 (3) | −0.0949 (3) | 0.3519 (2) | 0.0195 (5) |
| H1 | 0.3885 | −0.1954 | 0.3595 | 0.023* |
| C2 | 0.0467 (3) | 0.2021 (3) | 0.5111 (2) | 0.0182 (5) |
| H2 | 0.0854 | 0.1596 | 0.5823 | 0.022* |
| C3 | −0.0863 (3) | 0.3487 (3) | 0.5121 (2) | 0.0176 (5) |
| C4 | −0.1546 (3) | 0.4316 (3) | 0.4123 (2) | 0.0169 (5) |
| C5 | −0.2846 (3) | 0.5750 (3) | 0.4244 (2) | 0.0219 (5) |
| H5 | −0.3305 | 0.6324 | 0.3579 | 0.026* |
| C6 | −0.3469 (3) | 0.6339 (3) | 0.5313 (2) | 0.0251 (6) |
| H6 | −0.4350 | 0.7310 | 0.5376 | 0.030* |
| C7 | −0.2814 (3) | 0.5518 (3) | 0.6308 (2) | 0.0228 (5) |
| H7 | −0.3255 | 0.5921 | 0.7044 | 0.027* |
| C8 | −0.1529 (3) | 0.4126 (3) | 0.6205 (2) | 0.0209 (5) |
| H8 | −0.1075 | 0.3578 | 0.6877 | 0.025* |
| C9 | −0.0923 (3) | 0.0795 (3) | 0.2184 (2) | 0.0169 (5) |
| C10 | −0.2589 (3) | 0.1418 (3) | 0.2658 (2) | 0.0198 (5) |
| H10 | −0.2980 | 0.2304 | 0.3083 | 0.024* |
| C11 | −0.3678 (3) | 0.0742 (3) | 0.2509 (2) | 0.0239 (5) |
| H11 | −0.4807 | 0.1154 | 0.2847 | 0.029* |
| C12 | −0.3118 (3) | −0.0530 (3) | 0.1867 (2) | 0.0232 (5) |
| H12 | −0.3867 | −0.0980 | 0.1759 | 0.028* |
| C13 | −0.1469 (3) | −0.1150 (3) | 0.1383 (2) | 0.0208 (5) |
| H13 | −0.1090 | −0.2018 | 0.0940 | 0.025* |
| C14 | −0.0366 (3) | −0.0496 (3) | 0.1545 (2) | 0.0190 (5) |
| H14 | 0.0764 | −0.0928 | 0.1222 | 0.023* |
| C15 | 0.2105 (3) | 0.3034 (3) | 0.1105 (2) | 0.0167 (5) |
| C16 | 0.1485 (3) | 0.4688 (3) | 0.0857 (2) | 0.0219 (5) |
| H16 | 0.0481 | 0.5254 | 0.1320 | 0.026* |
| C17 | 0.2329 (3) | 0.5521 (3) | −0.0067 (2) | 0.0259 (6) |
| H17 | 0.1902 | 0.6650 | −0.0233 | 0.031* |
| C18 | 0.3795 (3) | 0.4691 (3) | −0.0743 (2) | 0.0265 (6) |
| H18 | 0.4366 | 0.5255 | −0.1378 | 0.032* |
| C19 | 0.4429 (3) | 0.3049 (3) | −0.0498 (2) | 0.0269 (6) |
| H19 | 0.5438 | 0.2490 | −0.0960 | 0.032* |
| C20 | 0.3588 (3) | 0.2211 (3) | 0.0427 (2) | 0.0214 (5) |

H2O 0.4025 0.1083 0.0595 0.026*

Atomic displacement parameters (\AA^2)

| | U^{11} | U^{22} | U^{33} | U^{12} | U^{13} | U^{23} |
|-----|--------------|--------------|-------------|--------------|--------------|--------------|
| Sn | 0.01591 (10) | 0.01400 (10) | 0.01511 (9) | −0.00329 (7) | −0.00194 (6) | −0.00308 (6) |
| O1 | 0.0194 (8) | 0.0179 (9) | 0.0227 (9) | −0.0005 (7) | −0.0027 (7) | −0.0052 (7) |
| O2 | 0.0207 (8) | 0.0184 (9) | 0.0173 (8) | −0.0005 (7) | −0.0038 (7) | −0.0050 (7) |
| N1 | 0.0217 (11) | 0.0159 (11) | 0.0248 (11) | −0.0023 (9) | −0.0081 (9) | 0.0001 (9) |
| N2 | 0.0176 (10) | 0.0138 (10) | 0.0182 (10) | −0.0059 (8) | −0.0041 (8) | −0.0003 (8) |
| C1 | 0.0153 (11) | 0.0123 (12) | 0.0278 (13) | −0.0025 (10) | −0.0057 (10) | 0.0015 (10) |
| C2 | 0.0236 (12) | 0.0185 (12) | 0.0157 (11) | −0.0127 (10) | −0.0039 (9) | 0.0011 (9) |
| C3 | 0.0206 (12) | 0.0166 (12) | 0.0172 (11) | −0.0102 (10) | 0.0003 (9) | −0.0034 (9) |
| C4 | 0.0181 (11) | 0.0165 (12) | 0.0161 (11) | −0.0079 (10) | 0.0009 (9) | −0.0041 (9) |
| C5 | 0.0195 (12) | 0.0207 (13) | 0.0232 (12) | −0.0027 (10) | −0.0039 (10) | −0.0054 (10) |
| C6 | 0.0183 (12) | 0.0259 (14) | 0.0295 (14) | −0.0045 (11) | 0.0020 (10) | −0.0134 (11) |
| C7 | 0.0251 (13) | 0.0261 (14) | 0.0182 (12) | −0.0125 (11) | 0.0050 (10) | −0.0098 (10) |
| C8 | 0.0271 (13) | 0.0211 (13) | 0.0163 (11) | −0.0131 (11) | −0.0010 (10) | −0.0017 (10) |
| C9 | 0.0185 (11) | 0.0166 (12) | 0.0137 (10) | −0.0049 (10) | −0.0037 (9) | 0.0009 (9) |
| C10 | 0.0218 (12) | 0.0185 (12) | 0.0179 (11) | −0.0053 (10) | −0.0016 (9) | −0.0054 (10) |
| C11 | 0.0182 (12) | 0.0267 (14) | 0.0256 (13) | −0.0076 (11) | 0.0008 (10) | −0.0074 (11) |
| C12 | 0.0257 (13) | 0.0227 (14) | 0.0243 (13) | −0.0110 (11) | −0.0060 (10) | −0.0030 (11) |
| C13 | 0.0267 (13) | 0.0153 (12) | 0.0199 (12) | −0.0048 (10) | −0.0044 (10) | −0.0057 (10) |
| C14 | 0.0193 (12) | 0.0185 (12) | 0.0158 (11) | −0.0033 (10) | −0.0019 (9) | −0.0025 (9) |
| C15 | 0.0184 (11) | 0.0184 (12) | 0.0149 (11) | −0.0071 (10) | −0.0031 (9) | −0.0036 (9) |
| C16 | 0.0219 (12) | 0.0214 (13) | 0.0192 (12) | −0.0038 (11) | −0.0030 (10) | −0.0031 (10) |
| C17 | 0.0314 (14) | 0.0203 (14) | 0.0249 (13) | −0.0102 (12) | −0.0057 (11) | 0.0019 (11) |
| C18 | 0.0296 (14) | 0.0297 (15) | 0.0221 (13) | −0.0164 (12) | −0.0016 (11) | −0.0007 (11) |
| C19 | 0.0228 (13) | 0.0328 (16) | 0.0246 (13) | −0.0110 (12) | 0.0037 (11) | −0.0104 (12) |
| C20 | 0.0211 (12) | 0.0214 (13) | 0.0218 (12) | −0.0060 (11) | −0.0028 (10) | −0.0070 (10) |

Geometric parameters (\AA , $^\circ$)

| | | | |
|--------|-------------|---------|-----------|
| Sn—O1 | 2.1470 (18) | C9—C10 | 1.397 (3) |
| Sn—O2 | 2.0654 (17) | C9—C14 | 1.399 (3) |
| Sn—N2 | 2.162 (2) | C10—C11 | 1.392 (4) |
| Sn—C9 | 2.120 (2) | C10—H10 | 0.9500 |
| Sn—C15 | 2.125 (2) | C11—C12 | 1.387 (4) |
| O1—C1 | 1.299 (3) | C11—H11 | 0.9500 |
| O2—C4 | 1.325 (3) | C12—C13 | 1.388 (4) |
| N1—C1 | 1.299 (3) | C12—H12 | 0.9500 |
| N1—N2 | 1.411 (3) | C13—C14 | 1.396 (4) |
| N2—C2 | 1.299 (3) | C13—H13 | 0.9500 |
| C1—H1 | 0.9500 | C14—H14 | 0.9500 |
| C2—C3 | 1.431 (4) | C15—C16 | 1.391 (4) |
| C2—H2 | 0.9500 | C15—C20 | 1.396 (3) |
| C3—C4 | 1.418 (3) | C16—C17 | 1.395 (4) |
| C3—C8 | 1.418 (3) | C16—H16 | 0.9500 |

| | | | |
|-----------|-------------|-------------|-------------|
| C4—C5 | 1.405 (3) | C17—C18 | 1.387 (4) |
| C5—C6 | 1.381 (4) | C17—H17 | 0.9500 |
| C5—H5 | 0.9500 | C18—C19 | 1.383 (4) |
| C6—C7 | 1.402 (4) | C18—H18 | 0.9500 |
| C6—H6 | 0.9500 | C19—C20 | 1.397 (4) |
| C7—C8 | 1.371 (4) | C19—H19 | 0.9500 |
| C7—H7 | 0.9500 | C20—H20 | 0.9500 |
| C8—H8 | 0.9500 | | |
| O2—Sn—C9 | 96.23 (8) | C7—C8—H8 | 119.2 |
| O2—Sn—C15 | 95.10 (8) | C3—C8—H8 | 119.2 |
| O1—Sn—O2 | 158.42 (7) | C10—C9—C14 | 119.4 (2) |
| O1—Sn—N2 | 73.94 (7) | C10—C9—Sn | 119.82 (18) |
| O2—Sn—N2 | 84.49 (7) | C14—C9—Sn | 120.82 (17) |
| C9—Sn—C15 | 124.62 (9) | C11—C10—C9 | 120.2 (2) |
| C9—Sn—O1 | 93.72 (8) | C11—C10—H10 | 119.9 |
| C15—Sn—O1 | 94.91 (8) | C9—C10—H10 | 119.9 |
| C9—Sn—N2 | 115.22 (8) | C12—C11—C10 | 120.1 (2) |
| C15—Sn—N2 | 119.75 (8) | C12—C11—H11 | 119.9 |
| C1—O1—Sn | 112.38 (15) | C10—C11—H11 | 119.9 |
| C4—O2—Sn | 132.88 (16) | C13—C12—C11 | 120.3 (2) |
| C1—N1—N2 | 110.2 (2) | C13—C12—H12 | 119.9 |
| C2—N2—N1 | 115.7 (2) | C11—C12—H12 | 119.9 |
| C2—N2—Sn | 128.20 (17) | C12—C13—C14 | 119.9 (2) |
| N1—N2—Sn | 116.09 (14) | C12—C13—H13 | 120.0 |
| O1—C1—N1 | 127.4 (2) | C14—C13—H13 | 120.0 |
| O1—C1—H1 | 116.3 | C13—C14—C9 | 120.1 (2) |
| N1—C1—H1 | 116.3 | C13—C14—H14 | 119.9 |
| N2—C2—C3 | 126.6 (2) | C9—C14—H14 | 119.9 |
| N2—C2—H2 | 116.7 | C16—C15—C20 | 119.5 (2) |
| C3—C2—H2 | 116.7 | C16—C15—Sn | 119.48 (17) |
| C4—C3—C8 | 118.8 (2) | C20—C15—Sn | 120.95 (18) |
| C4—C3—C2 | 124.0 (2) | C15—C16—C17 | 120.4 (2) |
| C8—C3—C2 | 117.1 (2) | C15—C16—H16 | 119.8 |
| O2—C4—C5 | 117.7 (2) | C17—C16—H16 | 119.8 |
| O2—C4—C3 | 123.6 (2) | C18—C17—C16 | 119.7 (3) |
| C5—C4—C3 | 118.7 (2) | C18—C17—H17 | 120.2 |
| C6—C5—C4 | 121.0 (2) | C16—C17—H17 | 120.2 |
| C6—C5—H5 | 119.5 | C19—C18—C17 | 120.4 (2) |
| C4—C5—H5 | 119.5 | C19—C18—H18 | 119.8 |
| C5—C6—C7 | 120.7 (2) | C17—C18—H18 | 119.8 |
| C5—C6—H6 | 119.7 | C18—C19—C20 | 120.1 (2) |
| C7—C6—H6 | 119.7 | C18—C19—H19 | 119.9 |
| C8—C7—C6 | 119.2 (2) | C20—C19—H19 | 119.9 |
| C8—C7—H7 | 120.4 | C15—C20—C19 | 119.9 (2) |
| C6—C7—H7 | 120.4 | C15—C20—H20 | 120.1 |
| C7—C8—C3 | 121.5 (2) | C19—C20—H20 | 120.1 |

| | | | |
|--------------|--------------|-----------------|--------------|
| O2—Sn—O1—C1 | 3.5 (3) | C4—C3—C8—C7 | 0.2 (4) |
| C9—Sn—O1—C1 | −113.83 (16) | C2—C3—C8—C7 | −179.5 (2) |
| C15—Sn—O1—C1 | 120.93 (16) | O2—Sn—C9—C10 | −13.3 (2) |
| N2—Sn—O1—C1 | 1.36 (15) | C15—Sn—C9—C10 | −113.89 (19) |
| C9—Sn—O2—C4 | 110.4 (2) | O1—Sn—C9—C10 | 147.53 (19) |
| C15—Sn—O2—C4 | −123.9 (2) | N2—Sn—C9—C10 | 73.5 (2) |
| O1—Sn—O2—C4 | −6.5 (3) | O2—Sn—C9—C14 | 167.59 (19) |
| N2—Sn—O2—C4 | −4.4 (2) | C15—Sn—C9—C14 | 67.0 (2) |
| C1—N1—N2—C2 | 178.9 (2) | O1—Sn—C9—C14 | −31.6 (2) |
| C1—N1—N2—Sn | −0.2 (2) | N2—Sn—C9—C14 | −105.59 (19) |
| O2—Sn—N2—C2 | 1.3 (2) | C14—C9—C10—C11 | 0.9 (4) |
| C9—Sn—N2—C2 | −93.0 (2) | Sn—C9—C10—C11 | −178.21 (19) |
| C15—Sn—N2—C2 | 94.0 (2) | C9—C10—C11—C12 | −1.4 (4) |
| O1—Sn—N2—C2 | −179.5 (2) | C10—C11—C12—C13 | 0.8 (4) |
| O2—Sn—N2—N1 | −179.85 (16) | C11—C12—C13—C14 | 0.3 (4) |
| C9—Sn—N2—N1 | 85.85 (17) | C12—C13—C14—C9 | −0.8 (4) |
| C15—Sn—N2—N1 | −87.10 (17) | C10—C9—C14—C13 | 0.1 (4) |
| O1—Sn—N2—N1 | −0.65 (14) | Sn—C9—C14—C13 | 179.27 (18) |
| Sn—O1—C1—N1 | −2.3 (3) | O2—Sn—C15—C16 | −8.3 (2) |
| N2—N1—C1—O1 | 1.7 (3) | C9—Sn—C15—C16 | 92.9 (2) |
| N1—N2—C2—C3 | −177.4 (2) | O1—Sn—C15—C16 | −169.15 (19) |
| Sn—N2—C2—C3 | 1.5 (3) | N2—Sn—C15—C16 | −94.9 (2) |
| N2—C2—C3—C4 | −2.6 (4) | O2—Sn—C15—C20 | 174.43 (19) |
| N2—C2—C3—C8 | 177.1 (2) | C9—Sn—C15—C20 | −84.4 (2) |
| Sn—O2—C4—C5 | −176.08 (16) | O1—Sn—C15—C20 | 13.6 (2) |
| Sn—O2—C4—C3 | 4.7 (3) | N2—Sn—C15—C20 | 87.9 (2) |
| C8—C3—C4—O2 | 179.9 (2) | C20—C15—C16—C17 | 0.5 (4) |
| C2—C3—C4—O2 | −0.5 (4) | Sn—C15—C16—C17 | −176.82 (19) |
| C8—C3—C4—C5 | 0.7 (3) | C15—C16—C17—C18 | 0.1 (4) |
| C2—C3—C4—C5 | −179.7 (2) | C16—C17—C18—C19 | −0.6 (4) |
| O2—C4—C5—C6 | 179.9 (2) | C17—C18—C19—C20 | 0.6 (4) |
| C3—C4—C5—C6 | −0.8 (4) | C16—C15—C20—C19 | −0.5 (4) |
| C4—C5—C6—C7 | 0.1 (4) | Sn—C15—C20—C19 | 176.75 (19) |
| C5—C6—C7—C8 | 0.8 (4) | C18—C19—C20—C15 | 0.0 (4) |
| C6—C7—C8—C3 | −0.9 (4) | | |

Hydrogen-bond geometry (Å, °)

| <i>D</i> —H \cdots <i>A</i> | <i>D</i> —H | H \cdots <i>A</i> | <i>D</i> \cdots <i>A</i> | <i>D</i> —H \cdots <i>A</i> |
|-----------------------------------|-------------|---------------------|----------------------------|-------------------------------|
| C2—H2 \cdots Cg ⁱ | 0.95 | 2.93 | 3.872 (3) | 172 |
| C19—H19 \cdots O1 ⁱⁱ | 0.95 | 2.67 | 3.554 (3) | 154 |

Symmetry codes: (i) $-x, -y, -z+1$; (ii) $-x+1, -y, -z$.